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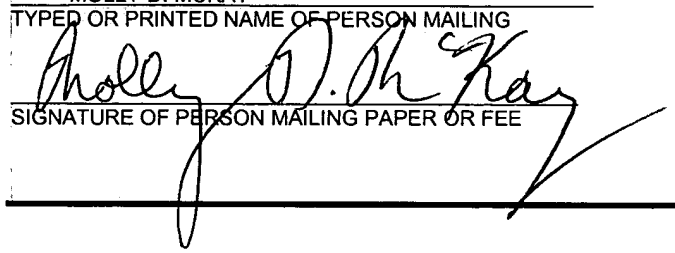

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UNITED STATES PATENT APPLICATION

FOR

METERING VALVE

METERING VALVE

CROSS- REFERENCE TO RELATED APPLICATIONS

The present invention is a continuation in part of U.S. Patent Application Serial No. 10/151,737 for Metering Valve filed on May 20, 2002.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a valve for metering dry bulk powdered materials, such as for example cement. The primarily purpose of this valve is to proportionally meter bulk material for a blending or mixing operation. This design has an approximately linear characteristic wherein equal displacements of the valve sleeve will obtain approximately equal increases in valve opening area. This arrangement makes it well suited to automatic control of bulk materials.

Specifically, the present invention is an improved metering valve that addresses a variety of problems related to current metering valves, i.e. the problems of dry powdered material accumulating between the valve sleeve and the valve housing thus making the valve hard to turn, excessive wear on the valve caused by the abrasive action of the dry powdered material, incomplete sealing the valve when the valve is closed, and dry powdered material plugging off the vacuum breakers provided on the valve. In addition "dirty" cement may contain small rocks and other foreign material that may interfere with the normal operation of the valve. The foreign material may lodge in between the valve

sleeve and body thus causing the valve not to turn or causing damage to the valve mating surfaces.

2. Description of the Related Art

Current metering valves employed to meter dry bulk powdered material, such as cement, present a variety of problems. First, current metering valves have a problem with dry powdered material accumulating between the valve sleeve and the valve housing. Because both the valve sleeve and the valve housing are circular in shape and the clearance between the valve sleeve and valve housing on current metering valves is uniform around the entire circumference of the valve sleeve, the dry powdered material tends to pack into the gap separating the valve sleeve and housing and forms a hardened layer between the two valve members. This hardened layer causes wear of the valve and can ultimately cause the valve sleeve to bind or freeze up within the housing. The valve must then be taken out of service and disassembled so that the hardened layer can be chipped off of the valve. Removing the valve from service for this type of maintenance is time consuming, labor intensive, and costly.

A second problem with current metering valves is that the leading edge of the sleeve opening provided in the valve sleeve is the point at which the greatest wear due to abrasion by the dry powdered material occurs. Excessive wear on the valve caused by the abrasive action of the dry powdered material allows more of the dry powdered material to enter the gap between the valve sleeve and the housing, thus acerbating the previously described problem of dry powdered material forming a hardened layer in the gap.

Also, with the leading edge of the sleeve opening worn by the abrasive action of the dry powdered material, the valve does not seal tightly when the valve is closed.

A final problem with current metering valves in that dry powdered material sometimes enters the mouths of the vacuum breakers provided in the valves and plugs off the openings to the vacuum breakers. If dry powder becomes plugged within the vacuum breakers, this may allow bulk material to be discharged externally, thus causing an environmental problem for the operator. He may not be able to see due to dust, and the dust is unhealthy to breathe. Current metering valves have the mouths of the vacuum breakers open to the housing of the valves, thus allowing dry powered material to fly into the mouths and come into contact with the moisture. The moistened powdered material will then set up and over time will completely plug the openings to the vacuum breakers, making the vacuum breakers inoperative.

The present invention addresses these problems by providing a metering valve with greater clearance between the valve sleeve and housing in the areas not adjacent to the metering edges of the housing. With greater clearance between the valve sleeve and housing except at the sealing surface or lip, the problem of creating an unwanted hardened layer or interference with foreign particles in the gap separating these valve elements is either eliminated or greatly improved.

The present invention also is provided with an eccentric intermediate sleeve that serves to align the valve sleeve relative to the housing. By rotating the intermediate sleeve slightly, this rotational motion of the intermediate sleeve translates into a back-and-forth motion of the valve sleeve, thus moving the valve sleeve either nearer or further from the front side of the valve body, i.e. the side of the valve body through which the dry powdered material enters the valve.

The ability to move the valve sleeve toward or away from the front side of the valve body independent of the rotational movement of the valve sleeve allows the valve sleeve to move away from the housing before it is rotated and then moved back toward the front side of the valve body once the valve sleeve has been rotated, thus forming a tight seal between the sleeve and sealing surface or lip located adjacent the inlet opening provided in the front side of the valve body for admitting dry powder material to the valve. A rubberized layer is added to the exterior surface of the valve sleeve to further enhance the seal between the valve sleeve and the housing. By moving the valve sleeve away from the housing employing the eccentric intermediate sleeve, the layer is disengaged from contact with the housing prior to the valve sleeve being rotated. Otherwise, the layer would be damaged when the valve was opened and closed.

In order to prevent dry powder material from blowing into the mouths of the vacuum breakers, a sleeve shield is provided in the present valve to cover the openings leading to the vacuum breakers. The sleeve shield is sealed to the

housing of the valve upstream of the openings that lead to the vacuum breakers, and the sleeve shield extends downstream of the openings.

Finally, the present invention employs ball bearings to suspend the valve sleeve within the housing, thereby making the valve sleeve easier to rotate.

SUMMARY OF THE INVENTION

The present invention is a metering valve with greater clearance between the valve sleeve and the areas of the housing not adjacent to the metering edges of the housing. This is achieved by employing a housing that, when viewed in cross section, has an interior surface that is not perfectly circular, but is instead expanded outward slightly just adjacent to the inlet opening of the housing. This creates greater clearance between the valve sleeve and the housing except at the sealing surface or lip of the valve. With this greater clearance within the valve, the problem of creating an unwanted hardened layer in the gap separating these valve elements, i.e. the housing and the metering sleeve, is either eliminated or greatly improved.

The present invention also is provided with an eccentric intermediate sleeve that serves to align the valve sleeve relative to the housing. By rotating the intermediate sleeve slightly, this rotational motion of the intermediate sleeve translates into a back-and-forth motion of the valve sleeve, thus moving the valve sleeve either nearer or further from the front side of the valve body, i.e. the side of the valve body through which the dry powdered material enters the valve.

The ability to move the valve sleeve toward or away from the front side of the valve body independent of the rotational movement of the valve sleeve allows the valve sleeve to move away from the housing before it is rotated and then moved back toward the front side of the valve body once the valve sleeve has been rotated, thus forming a tight seal between the sleeve and the inlet opening

provided in the front side of the valve body for admitting dry powder material to the valve. A rubberized layer is added to the exterior surface of the valve sleeve to further enhance the seal between the valve sleeve and the housing. By moving the valve sleeve away from the housing employing the eccentric intermediate sleeve, the layer is disengaged from contact with the housing prior to the valve sleeve being rotated. Otherwise, the layer would be damaged when the valve was opened and closed.

In order to prevent dry powder material from blowing into the mouths of the vacuum breakers, a sleeve shield is provided in the present valve to cover the openings leading to the vacuum breakers. The sleeve shield is sealed to the housing of the valve upstream of the openings that lead to the vacuum breakers, and the sleeve shield extends downstream of the openings.

Finally, the present invention employs ball bearings to suspend the valve sleeve within the housing, thereby making the valve sleeve easier to rotate.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a side view of the exterior of a metering valve for use with dry powdered material constructed in accordance with a preferred embodiment of the present invention.

FIGURE 2 is a top plan of the metering valve of figure 1.

FIGURE 3 is a cross sectional view taken along line 3-3 of figure 2.

FIGURE 4 is a cross sectional view of the housing and sleeve taken from the valve of figure 3.

FIGURE 5 is a cross sectional view of the housing taken along line 5-5 from figure 4 with the valve sleeve shown in a closed position relative to the housing.

FIGURE 6 is an enlarged view of the portion of figure 5 indicated by the circled labeled "Fig.6".

FIGURE 7 is a cross sectional view of the valve taken along line 7-7 of figure 1 with the valve shown in a closed and sealed position.

FIGURE 8 is a cross sectional view of the valve similar to figure 7 with the valve shown in a closed but unsealed position.

FIGURE 9 is an enlarged view of the portion of figure 9 indicated by the circled labeled "Fig. 9".

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

INVENTION

Referring now to the drawings and initially to figures 1-3, there is illustrated a metering valve **10** that is constructed in accordance with a preferred embodiment of the present invention. The valve **10** is provided with a housing **12** having an dry powder inlet **14** which communicates via an inlet opening **16** to the hollow interior **18** of the valve **10** and through which dry bulk powder material, indicated in figure 3 by arrow **A**, is admitted to the hollow interior **18** of the valve **10**.

A valve sleeve **20** is provided rotatably suspended within the housing **12** so that the valve sleeve **20** completely covers the inlet opening **16** then the valve sleeve is rotated to the closed position **22** and so that the valve sleeve **20** can be rotated to gradually open the valve **10**. Figure 5 illustrates the valve sleeve **20** in the closed position **22** and sealed position. Whenever the valve **10** is open, dry powder material passes through the hollow interior **18** of the valve **10** and exits the valve **10** via an outlet opening **24** provided in the housing **12**, as shown in figure 3 by arrow **B**. The valve sleeve **20** is normally rotated via a hydraulic rotary actuator (not illustrated) that bolts onto a distal end **66** of the shaft **40**. Alternately, the valve sleeve **20** can be manually rotated by employing a tool that removably inserts into openings **64** provided in a manual input wheel **65** that is secured to and rotates in conjunction with the shaft **40**.

As shown in figures 3 and 5, the housing **12** of the metering valve **10** is provided with greater clearance or a larger gap **26** between the valve sleeve **20** and the housing **12** on the back side **28** of the valve **10**, i.e. the side of the valve **10** opposite the inlet opening **16**, and everywhere within the housing except at the sealing surface or lip **63** provided on the front side **44** of the valve **10** adjacent the inlet opening **16**. Figure 5 shows in dashed lines the path of rotation of the valve sleeve **20** as the valve sleeve **20** is rotated within the housing **12**. Immediately adjacent to the sealing surface or lip **63** in the housing **12**, the internal surface **30** of the housing **12** begins to become larger, thus creating a significantly increased clearance or gap **26**. This clearance or gap **26** gradually increases to a maximum at the opposite or back side **28** of the valve **10**. This increasing gap **26** is achieved by employing a housing **12** that, when viewed in cross section, has an interior surface **30** that is not perfectly circular, but is instead expanded rapidly outward adjacent to the sealing surface or lip **63** and continues to expand outward slightly at the back side **28** of the housing **12**. This creates greater clearance or a larger gap **26** between the valve sleeve **20** and the interior surface **30** of the housing **12** everywhere except at the sealing surface or lip **63**. This greater clearance or larger gap **26** of the valve **10** tends to prevent the dry powder material from being compacted, thereby preventing or greatly slowing down the formation of an unwanted hardened layer in the gap **26**. Also, this gap prevents large particles and foreign material from interfering with the housing **12** and valve sleeve **20**.

The valve **10** is also provided with an eccentric intermediate sleeve **32** that serves to align the valve sleeve **20** relative to the housing **12**. The intermediate sleeve **32** is located eccentric relative to a centerline **10** of the valve **10** and therefore eccentric relative to the interior surface **30** of the housing **12**. The intermediate sleeve **32** is attached to a lever **36** for mechanically rotating the intermediate sleeve **32** relative to the housing **12**. The intermediate sleeve **32** is provided with a first pair of ball bearing bushings **38** located between the sleeve shaft **40** and the intermediate sleeve **32** and in which the sleeve shaft **40** rotates. The intermediate sleeve **32** is also provided with a second pair of ball bearing bushings **62** located between the intermediate sleeve **32** and the housing **12** in which the intermediate sleeve **32** rotates. Ball bearings are preferably employed in bushings **38** and **62** because the ball bearings allow easier rotation of the sleeve shaft **40** and intermediate sleeve **32**. The valve sleeve **20** is attached to one end **42** of the sleeve shaft **40**. By rotating the intermediate sleeve **32**, this rotational motion of the intermediate sleeve **32** translates into a back-and-forth motion of the valve sleeve **20**, thus moving the valve sleeve **20** either nearer to or further from a front side **44** of the valve **10**, i.e. the side of the valve **10** through which the dry powdered material enters the valve **10**, depending on which way the intermediate sleeve **32** is rotated.

The ability to move the valve sleeve **20** toward or away from the front side **44** of the valve **10** independent of the rotational movement of the valve sleeve **20** allows the valve sleeve **20** to move away from the housing **12** at the front side **44**

of the valve **10** before the valve sleeve **20** is rotated via the sleeve shaft **40** to open and close the valve **10**, and allows the valve sleeve **20** to then move back toward the front side **44** of the valve **10** once the valve sleeve **20** has been rotated. By moving the valve sleeve **20** toward the housing **12** at the front side **44** of the valve **10**, the valve sleeve **20** thus forms a tighter seal between the valve sleeve **20** and the inlet opening **16** than would otherwise be possible.

Referring now to figures 5 and 6, to further enhance the seal formed between the inlet opening **16** of the housing **12** and the valve sleeve **20**, an exterior surface **48** of the valve sleeve **20** is coated with a rubberized layer **50**. This rubberized layer **50** seats against a sealing surface in the form of a lip **63** provided on the interior surface **30** of the housing **12** so that the lip **63** encircles that portion of the housing **12** adjacent to and opening into the inlet opening **16**.

Figure 7 illustrates the relative position of the valve sleeve **20** to the housing **12**, and more specifically the relative position of the rubberized layer **50** of the valve sleeve **20** to the lip **63** provided on the housing **12**, when the valve **10** is closed and sealed. Numeral **61** represents the centerline for the eccentric intermediate sleeve **32**. In this closed position **22**, the rubberized layer **50** is tightly abutted against the lip **63**, thereby preventing material from entering the hollow interior **10** of the valve **10**.

Figure 8 illustrates the relative position of the valve sleeve **20** and the rubberized layer **50** to the lip **63** when the lever **36** is employed to rotate the eccentric intermediate sleeve **32**, thereby causing the valve sleeve **20** to move

away from the lip **63** and thus disengaging the rubberized layer **50** from the lip **63**. Figures 8 and 9 show the valve **10** in a closed position but unsealed condition, as indicated by numeral **22'**. By employing the eccentric intermediate sleeve **32** to move the valve sleeve **20** away from the lip **63** of the housing **12**, the layer **50** is disengaged from contact with the housing **12** prior to the valve sleeve **20** being rotated, thereby creating a gap **68** between the lip **63** and the layer **50**, as illustrated in Figure 9. The eccentric intermediate sleeve **32** is used prior to opening, closing, or rotating the valve sleeve **20**. Without the eccentric intermediate sleeve **32**, the layer **50** would be damaged when the valve **10** was opened, closed, or otherwise rotated.

In order to prevent dry powder material from blowing into the mouths **52** of vacuum breakers **54** that are provided on the valve **10**, a sleeve shield **56** is provided within the present valve **10**. The sleeve shield **56** shields the mouths **52** from the flow of dry powder material passing through the hollow interior **18** of the valve **10**. The sleeve shield **56** is secured by means of bolts **58** and a sealing ring **60** to the interior surface **30** of the housing **12** immediately upstream of the mouths **52** of the vacuum breakers **54**. As shown in figure 4, the housing is provided with bolt openings **46** for receiving the bolts **58**. Sleeve shield **56** extends downstream of the mouths **52** of the vacuum breakers **54** to thereby prevent dry powdered material from being directly blown into the mouths **52** where the dry powder material could become wetted and cause blockage of the mouths **52**.

Finally, the bushings **38** and **62** that are provided in association with the intermediate sleeve **32** and that rotatably suspend the sleeve shaft **40** and the attached valve sleeve **20** within the housing **12** utilize ball bearings, thereby making the intermediate sleeve **32** and the valve sleeve **20** easier to rotate.

While the invention has been described with a certain degree of particularity, it is manifest that many changes may be made in the details of construction and the arrangement of components without departing from the spirit and scope of this disclosure. It is understood that the invention is not limited to the embodiments set forth herein for the purposes of exemplification, but is to be limited only by the scope of the attached claim or claims, including the full range of equivalency to which each element thereof is entitled.